### Table S1. Characteristics of frailty instruments utilized in individual studies

<table>
<thead>
<tr>
<th>Reference/Frailty instrument name</th>
<th>Study name, setting, country</th>
<th>Characteristics of population: N, age (mean (SD); range), % female</th>
<th>Components</th>
<th>Classification</th>
<th>Comment</th>
</tr>
</thead>
</table>
| Strawbridge et al, 1998 [31]: 1994 Frailty Measure | The Alameda County Study, Prospective cohort, USA | Community-dwelling population N=574 74.0 years; 65+ 57.0% | 4 domains: Physical functioning:  
- Sudden loss of balance  
- Weakness in arms  
- Weakness in legs  
- Dizziness when standing up quickly  
Nutritive functioning:  
- Loss of appetite  
- Unexplained weight loss  
Cognitive functioning:  
- Difficulty paying attention  
- Trouble finding the right word  
- Difficulty remembering things  
- Forgetting where put something  
Sensory problems:  
- Difficulty reading a newspaper  
- Difficulty in recognizing a friend across the street  
- Difficulty reading signs at night  
- Hearing over the phone  
- Hearing a normal conversation  
- Hearing a conversation in a noisy room | Score for the 6 sensory items:  
1: have no difficulty  
2: have a little difficulty  
3: have some difficulty  
4: have a great deal of difficulty.  
Scores on the other 10 items:  
1: rarely or never had the problem in the last 12 months  
2: sometimes had the problem  
3: often had the problem  
4: very often had the problem | Participant was |
<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Description</th>
<th>Measures</th>
<th>Frailty Definition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dayhoff et al, 1998 [30]</td>
<td>Subsample of a larger study examining effects of two exercise interventions,</td>
<td>Performance of ADLs/IADLs using the World Health Organisation Assessment of Functional Capacity (14 items, each scored from 1 to 5 (5=unable to perform))</td>
<td>Fraility defined as disability.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross-sectional analysis, USA</td>
<td>Self-report of perceived health.</td>
<td>Score range: 14 (self-sufficiency) to 70 (total dependency)</td>
<td></td>
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<tr>
<td></td>
<td>Community-dwelling participants N=84</td>
<td></td>
<td>Non-frail if score ≤20 &amp; excellent/good health.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-frail: 73.2 years (6.0) Frail: 73.5 years (7.9)</td>
<td></td>
<td>Frail if score ≥21 &amp; fair/poor health.</td>
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<tr>
<td></td>
<td>Age range: 60 to 88 years 85.7%</td>
<td></td>
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<tr>
<td>Rockwood et al, 1999 [32]: CSHA rules</td>
<td>The Canadian Study of Health and Aging (CSHA), Prospective cohort, Canada</td>
<td>0: Those who walk without help, perform basic ADL, are continent of bowel and bladder, and are not cognitively impaired</td>
<td>Fraility defined as disability or comorbidity.</td>
<td></td>
</tr>
<tr>
<td>based definition</td>
<td>Random sample of community residents N=not reported</td>
<td>1: Bladder incontinence only</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>65+</td>
<td>2: One (two if incontinent) or more of needing assistance with mobility or ADL, has cognitive impairment with no dementia, or has bowel or bladder incontinence</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>%=not available</td>
<td>3: Two (or three if incontinent) or more of totally dependent for transfers or one or more ADL, incontinent of bowel and bladder, and diagnosis of dementia.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steverink et al, 2001 [33]: Groningen</td>
<td>Cross-sectional study, Netherlands</td>
<td>15 items scored 0 or 1: Mobility (4 items) Comorbidity Malnutrition Cognition Vision</td>
<td>Fraility defined as disability or comorbidity. Need further explanation in the GFI</td>
<td></td>
</tr>
<tr>
<td>fraility indicator (GFI) (manual search)</td>
<td>Hospital inpatients, nursing home residents and community-dwelling elderly N=275</td>
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<tr>
<td></td>
<td>78.0 years (7.0), range=64-155</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Methodology</td>
<td>Participants</td>
<td>Scoring/Assessment</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------------</td>
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<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mitnitski et al, 2002 [34]: Frailty index (FI)</td>
<td>The Canadian Study of Health and Aging (CSHA), Prospective cohort, Canada</td>
<td>Random sample of community residents N=2914 82.0 years (7.4); 65+ 64.4%</td>
<td>20 “deficits” (symptoms, signs, impairments and disabilities) Impairment index: 0 to 1</td>
<td>No clear cut-off between frail vs non-frail. No standardised number and type of deficits. Frailty defined as disability or comorbidity.</td>
</tr>
<tr>
<td>Gerdhem et al, 2003 [35]: Subjective Frailty Score</td>
<td>Cross-sectional analysis Sweden</td>
<td>Participants randomly selected from the city files of Malmo N=993 75 years 100%</td>
<td>To make a general assessment of health and appearance within 15 sec from first sight, and transfer this into an arbitrary scale. Score ranging from 1 (low frailty) to 100 (very frail).</td>
<td>No clear cut-off between frail vs non-frail.</td>
</tr>
<tr>
<td>Cacciatore et al, 2005 [36]:</td>
<td>Osservatorio Geriatrico Regione Campania, Random sample of subjects with/without chronic heart failure, community-dwelling</td>
<td>7 core domains of functioning scored 0 (function is preserved) or 1 (function is lost): BADL disability</td>
<td>Class 1: 0 or 1 Class 2: 2 or 3</td>
<td>Frailty defined as disability.</td>
</tr>
</tbody>
</table>
| **Frailty Staging System** | Prospective cohort, Italy  
Based from Lachs et al, 1990, USA [57] | or institutionalised elderly  
N=1332  
75.9 years (6.7)  
60% | • Mobility (ability to do heavy housework, to walk up and down stairs to the second floor and to walk half a mile)  
• Cognitive function  
• Visual function  
• Hearing function  
• Urinary continence  
• Social support | Class 3: ≥4 |
| --- | --- | --- | --- | --- |
| **Amici et al, 2008 [38]: Marigliano-Cacciafesta Polypathological Scale (MCPS)** | Cross-sectional design, Italy | N=180  
79.5 years; 70+  
63.9% | • Neurological disorders (5 items)  
• Cardiopathy (4 items)  
• Respiratory disorders (5 items)  
• Renal disorders (4 items)  
• Locomotive apparatus disorders (5 items)  
• Sensory deprivation (5 items)  
• Metabolism and nutritional state (5 items)  
• Cognitive state and mood (5 items)  
• Peripheral vascular system (5 items)  
• Malignant cancerous disorders (5 items)  
• Gastroenteritis disorders (5 items) | Score range: 0 to 245.  
Polypathology:  
Slight: <15  
Medium: 15-24  
Medium-severe: 25-49  
Severe: 50-74  
Very severe: 75+  
Missing information about population characteristics  
Rationale for weighting scores not explained.  
Frailty defined as comorbidity.  
Dose-response effect not shown. |
| **Kanauchi et al, 2008 [39]: Based on Morris et al, 1984, USA [146]: Hebrew Rehabilitation Center for Aged (HRCA) Vulnerability Index and Saliba et al, 2001, USA [58]: Vulnerable Elders Survey-13 (VES-13)** | Cross-sectional study, Japan | Hospital inpatients with cardiometabolic risk factors  
N=101  
72.9 years (5.1); range 65-85  
43.6% | **HRCA Vulnerability Index (2 components):**  
A component includes self-reported requirements for help in:  
• Preparing meals (score 0 or 1)  
• Taking out the garbage (score 0 or 1)  
• Doing ordinary work around the house (score 0 or 1)  
• Walking up and down stairs (score 0 or 1)  
• Needing to use a cane (score 0 or 1)  
• Needing to use a walker (score 0 or 1)  
• Identifying the current year (score 0 or 1)  
B component includes self-reported answers for:  
• Leaving their residence (score 0 or 1)  
• Needing help in dressing (score 0 or 1) | **HRCA Vulnerability Index:**  
Vulnerable if A component score>1 or A component score=1 and B component>0  
**VES-13:**  
Score range: 0 to 10  
Frail if score ≥3  
Participants were frail if they were considered as vulnerable according to the HRCA Vulnerability Index or frail according to the
Frailty defined as disability. |
<table>
<thead>
<tr>
<th>Study (Ref.)</th>
<th>Design</th>
<th>Country</th>
<th>Population</th>
<th>Instruments</th>
<th>Score Range</th>
<th>Cut-off</th>
</tr>
</thead>
</table>
| Gobbens et al., 2010 [40]: Tilburg Frailty Indicator (TFI) | Cross-sectional design, Netherlands | 2 random samples of community-dwelling participants | Sample 1: n=245, 80.3 years (3.9), 54.7%  
Sample 2: n=234, 80.2 years (3.7), 59.0% | 15 items scored 0 or 1:  
8 physical domains:  
- Feeling physically healthy  
- Unexpected weight loss  
- Difficulty in walking  
- Difficulty in maintaining balance  
- Hearing problems  
- Vision problems  
- Lack of strength in hands  
- Physical tiredness  
4 psychological domains:  
- Cognition  
- Depressive symptoms  
- Anxiety  
- Coping  
3 social domains:  
- Living alone  
- Social relations  
- Social support | Score range: 0 to 15 (15=highest score for frailty) | No clear cut-off between frail vs non-frail. |

**Objective frailty instruments**

<table>
<thead>
<tr>
<th>Study (Ref.)</th>
<th>Design</th>
<th>Country</th>
<th>Population</th>
<th>Instruments</th>
<th>Score Range</th>
<th>Cut-off</th>
</tr>
</thead>
</table>
| Brown et al., 2000 [41]: Modified Physical Performance Test (PPT) | Cross-sectional analysis, USA | Community-dwelling elderly N=107 | 83 years (4); 77+% | 9 items scored 0 to 4:  
- Lift a 7-pound book to a shelf  
- Put on and remove a jacket  
- Pick up penny from floor  
- Performance of a 360 degrees turn  
- 50-foot walk test  
- Climb one flight of stairs  
- Climb up and down 4 flights of stairs | Score range: 0-36 | Not frail: 32-36  
Mild frailty: 25-36  
Moderate frailty: 17-24  
Dependent: <17 |
<table>
<thead>
<tr>
<th>Gill et al, 2002 [42]</th>
<th>Primary care practices, Randomized controlled trial, USA</th>
<th>Community-dwelling elderly N=188 Intervention group: n=94, 82.8 years (5.0); 75+, 80% Control group: n=94, 83.5 years (5.2); 75+, 70%</th>
<th>• Stand up 5 times from a 16-inch chair • Progressive Romberg test • Rapid gait (walking back and forth over a 10-foot (3-m) course as quickly as possible) • Single chair stand</th>
<th>Moderately frail if rapid gait&gt;10 s or could not stand from the chair. Severely frail if meet both criteria.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klein et al, 2003 [43]: Frailty index</td>
<td>Beaver Dam Eye Study, Prospective cohort, USA</td>
<td>Sample from a private census of the population of Beaver Dam 43+ years</td>
<td>• Timed 10-ft walk (score=1 if in the highest quartile, stratified by sex) • Handgrip strength (score=1 if in the lowest quartile, stratified by sex) • Peak expiratory flow rate (score=1 if in the lowest quartile, stratified by sex) • Ability to stand from a sitting position without using arms in one try (score=1 if unable)</td>
<td>Score range: 0 (better) to 4 (worse)</td>
</tr>
<tr>
<td>Bandinelli, 2006 [44]: Short Physical Performance Battery (SPPB)</td>
<td>The FRAilty Screening and Intervention trial, Italy</td>
<td>Community-dwelling elderly visiting their primary care physicians N=251 Treatment group: n=126, 76.4 years (3.6), 66% Control group: n=125, 76.4 years (3.4), 60%</td>
<td>3 items scored 0 (unable to perform complete the test) to 4 (highest level of performance): • Walking speed over 4 metres • 5 timed repeated chair rises • Standing balance</td>
<td>Score range: 0 to 12 Frail if ≤9</td>
</tr>
<tr>
<td>Opasich et al, 2010 [45]</td>
<td>Hospital based, study of effect of personalized versus usual physiotherapy, Italy</td>
<td>Patients after receiving a cardiac surgery procedure N=224</td>
<td>• Balance Performance Oriented Mobility Assessment (BPOMA): assessment of static and dynamic balance • Get-Up-and-Go (GUG) test</td>
<td>Non-frail: BPOMA&gt;19 and GUG ≤10s Moderately frail:</td>
</tr>
<tr>
<td>Intervention group:</td>
<td>Control group:</td>
<td></td>
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<td>---------------------</td>
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<tr>
<td>n=150, 74.6 years (3.6); 70+, 40%</td>
<td>n=74, 75 years (3.9); 70+, 45%</td>
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</tr>
</tbody>
</table>

**BPOMA≤19 or GUG >10s**

**Severely frail:** BPOMA≤19 and GUG >10s

### Mixed (subjective and objective) frailty instruments

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Score</th>
<th>Frailty classification</th>
</tr>
</thead>
</table>
| Speechley & Tinetti, 1991 [46] | Subsample of the Yale Health and Aging Project (YHAP) of the Established Populations for Epidemiologic Study of the Elderly (EPESE) program. Prospective cohort, USA. | Community dwelling elderly, N=336, 75+ years | Frail attributes (each item scored 0 or 1):  
- Age ≥80 years  
- Gait/balance abnormalities  
- Infrequent walking for exercise  
- Depressed  
- Taking sedatives  
- Decreased strength in shoulder  
- Decreased strength in knee  
- Lower extremity disability  
- Near vision loss  
Vigorous attributes (each item scored 0 or 1):  
- Age <80 years  
- Cognitively intact  
- Frequent physical exercise other than walking  
- Good near vision | Score: 0-9 frail attributes  
0-4 vigorous attributes  
Frail: ≤1 vigorous and ≥4 frail attributes.  
Vigorous: ≥3 vigorous and ≤2 frail attributes.  
Transitional: neither frail nor vigorous. |
| Fried et al, 2001 [47]: Phenotype of Frailty | Cardiovascular Health Study (CHS), Prospective cohort, USA. | Community dwelling elderly from 4 US communities, N=5317, 65+ years, 57.9% | 5 items, each scored 0 or 1:  
- Unintentional weight loss  
- Self-reported exhaustion  
- Weakness (grip strength) (1 if in the lowest quintile)  
- Slow walking speed (1 if in the highest quintile)  
- Low physical activity (1 if in the lowest quintile) | Score range: 0 to 5  
0: frail  
1-2: pre-frail  
≥3: frail |
| Binder et al, 2002 [48]: Physical frailty | Randomized controlled trial, USA. | Community-dwelling elderly, N=444, 83 years (4); 78+ | Modified Physical Performance Test score (see Brown et al, 2000) of 18-32  
- Peak oxygen consumption: 11-18 ml/kg  
- Self-reported difficulty or need for | Mild to moderate frailty if ≥2  
Instrument contained disability component.  
Instrument used exclusively to select mild to moderate frailty |
<table>
<thead>
<tr>
<th>Study</th>
<th>Instrumentation Details</th>
<th>Sample Size</th>
<th>Setting</th>
<th>Frailty Defined</th>
<th>Follow-up</th>
<th>Evaluation Method</th>
<th>Needs Clinical Interview</th>
<th>Lower Cut-off Between Frail vs Non-Frail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studenski et al, 2004 [49]: Clinical Global Impression of Change in Physical Frailty (CGIC-PF)</td>
<td>Qualitative and quantitative instrument development, USA</td>
<td>N=not available</td>
<td>USA</td>
<td>Change evaluated after 6 months of follow-up, scored from 1 (worse) to 7 (better).</td>
<td>No clear cut-off between frail vs non-frail.</td>
<td>Frailty defined as disability / comorbidity.</td>
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</tr>
<tr>
<td>Puts et al, 2005 [51]: Static/Dynamic frailty index</td>
<td>Longitudinal Aging Study Amsterdam (LASA), Prospective cohort, Netherlands</td>
<td>Random sample drawn from registers N=1152</td>
<td>Netherlands</td>
<td>Static frail if ≥3 components. Dynamic frail if decline or loss ≥3.</td>
<td>Inclusion of one item of disability.</td>
<td>Inspired from Fried et al's instrument.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carriere et al, 2005 [50]: Score-Risk Correspondence for dependency</td>
<td>Epidemiologie de l’Osteoporose (EPIDOS) study, Prospective cohort, France</td>
<td>Random sample drawn from vote-registration or health-insurance membership rolls N=545</td>
<td>France</td>
<td>Score: 25-169 Risk: 0.02-0.99</td>
<td>No clear cut-off between frail vs non-frail.</td>
<td></td>
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<tr>
<td>Rolfson et al, 2006 [52]: Edmonton Frail Scale (EFS)</td>
<td>Hospital based, Cross-sectional analysis,</td>
<td>Sample of patients referred for a comprehensive geriatric assessment (CGA)</td>
<td></td>
<td>Score 0-17 (17=highest level of frailty)</td>
<td>No clear cut-off between frail vs non-frail.</td>
<td>Frailty defined as</td>
<td></td>
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</tbody>
</table>

**Notes:**
- CGIC-PF: Clinical Global Impression of Change in Physical Frailty
- CGA: Comprehensive Geriatric Assessment
- CES-D: Center for Epidemiologic Studies Depression Scale
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>N</th>
<th>Age (Mean ± SD)</th>
<th>Frailty Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(manual research)</td>
<td>Canada</td>
<td>158</td>
<td>80.4 ± 6.8; 65+</td>
<td>Social support (score 0 to 2)</td>
<td>disability.</td>
</tr>
<tr>
<td>Ensrud et al, 2008 [53]: Study of Osteoporotic Fractures (SOF) index</td>
<td>USA</td>
<td>6701</td>
<td>76.7 ± 4.8; 69+</td>
<td>Social support (score 0 to 2)</td>
<td>Inspired from Fried et al’s instrument.</td>
</tr>
<tr>
<td>Hyde et al, 2010 [55]: FRAIL scale</td>
<td>Australia</td>
<td>3616</td>
<td>76.9 ± 3.6; 71+</td>
<td>Social support (score 0 to 2)</td>
<td>Inspired from Fried et al’s and Mitnitski’s instruments.</td>
</tr>
<tr>
<td>Freiheit et al, 2010 [54]: Brief Frailty Index</td>
<td>Canada</td>
<td>337</td>
<td>70.8 ± 5.9; 60+</td>
<td>Social support (score 0 to 2)</td>
<td>4 categories: 0; 1; 2; ≥3</td>
</tr>
<tr>
<td>Sundermann et al, 2011 [56]: Comprehensive Assessment of Frailty (CAF)</td>
<td>USA</td>
<td>400</td>
<td>80.1 ± 4.0; 74+</td>
<td>Social support (score 0 to 2)</td>
<td>Score range: 1-35</td>
</tr>
</tbody>
</table>

**Key:**
- **Social support:** scored 0 to 2
- **Medication use:** scored 0 to 1
- **Nutrition:** scored 0 to 1
- **Mood:** scored 0 to 1
- **Continence:** scored 0 to 2
- **Functional performance:** scored 0 to 2
- **Unintentional weight loss:** ≥5% in 2 years
- **Inability to rise from a chair 5 times without using arms**
- **Reduced energy level:** Geriatric Depression Scale
- **Fatigue:** SF-36
- **Resistance:** ability to climb a single flight of stairs (SF-36)
- **Ambulation:** ability to walk one block (SF-36)
- **Illnesses:** more than 5 (list of 14 diseases)
- **Loss of weight:** more than 5% (between 4 to 5 years)
- **Balance assessment**
- **Body mass index**
- **Trail Making Test Part B**
- **Geriatric Depression Scale**
- **Living alone**

**Score range:**
- Not frail: 1-10
- Moderately frail: 11-25
- Frail: ≥3
<table>
<thead>
<tr>
<th>51.5%</th>
<th>usual gait speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Weakness score (grip strength)</td>
<td></td>
</tr>
<tr>
<td>Physical performance tests, each scored 0 to 4:</td>
<td></td>
</tr>
<tr>
<td>- Standing static Balance</td>
<td></td>
</tr>
<tr>
<td>- Chair rise</td>
<td></td>
</tr>
<tr>
<td>- Put on and remove a jacket</td>
<td></td>
</tr>
<tr>
<td>- Pick up a pen from floor</td>
<td></td>
</tr>
<tr>
<td>- Turn 360 degrees</td>
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<tr>
<td>Laboratory tests, each scored 0 to 1:</td>
<td></td>
</tr>
<tr>
<td>- Serum albumin score</td>
<td></td>
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<tr>
<td>- Forced expiratory volume in 1 second</td>
<td></td>
</tr>
<tr>
<td>- Creatinine score</td>
<td></td>
</tr>
</tbody>
</table>

Rockwood et al’s CSHA-CFS scored 1 to 7

| | Severely frail: 25+ |

“Manual search” characterizes an article not referenced by Medline but found in the reference section of selected articles.